WE CLAIM:

1. A gas generating system comprising:

a duct assembly for ducting an air stream, the duct assembly having:

a bleed air inlet;

a ram air inlet;

an air stream exit; and

a control loop system;

a primary heat exchanger for receiving the air stream from the duct assembly and cooling the air stream, the primary heat exchanger located downstream from the bleed air inlet and located downstream from the ram air inlet;

a gas generating system heat exchanger for receiving the air stream from the duct assembly, cooling the air stream, and providing the cooled air stream to the duct assembly;

a first temperature sensor and a second temperature sensor, each sensor for determining temperature in the duct assembly and generating a temperature value corresponding to the temperature, each temperature sensor mechanically associated with the duct assembly;

a controller monitor for receiving a temperature value and a pressure value, and generating a corresponding command signal;

a valve for receiving and responding to the command signal, the valve selected from the group consisting of a pressure regulating and shutoff valve, check valve, a flow shutoff valve, an ejector shutoff valve, a thermal shutoff valve, an ASM shutoff valve, and an isolation valve;

an air separation module (ASM) assembly having a primary module and a secondary module, each module for receiving the air stream from the duct assembly; separating nitrogen enriched air (NEA) from the air stream; and providing the NEA to the duct assembly, the ASM assembly located

downstream from the temperature sensor;

a flow control orifice for controlling receiving and regulating NEA flow from the ASM assembly via the duct assembly, the flow control orifice associated with a portion of the duct assembly located downstream from the ASM assembly; and

an NEA check valve for preventing entry of contaminants into the ASM assembly, the NEA check valve located downstream from the flow control orifice.

2. The system of Claim 1, further comprising an ejector for drawing an air source to the gas generating system heat exchanger via the duct assembly, the air source used by the gas generating system heat exchanger for cooling purposes, the ejector further used for ejecting a portion of the air stream, the ejector mechanically associated with duct assembly.

3. The system of Claim 1, further comprising a filter for filtering contaminates from the air stream, the filter mechanically associated with the duct assembly.

4. The system of Claim 1, further comprising a panel indicator for visual confirmation of component status, the panel indicator electronically associated with the controller monitor.

5. The system of Claim 1, further comprising an altitude rate switch for monitoring changes in altitude and sending a signal corresponding to the change to the controller monitor.

6. The system of Claim 1, wherein the control loop system further comprises:

a control loop having:

a conduit for NEA transfer from the ASM assembly; and

a pressure sensor for determining pressure in the conduit and generating a pressure value corresponding to the pressure.

7. A gas generating system comprising:

a duct assembly for ducting an air stream, the duct assembly having:

a bleed air inlet;

a ram air inlet;

an air stream exit;

a control loop system having a control loop, the control loop comprising:

a conduit for nitrogen transfer from the ASM assembly; and

a pressure sensor for determining pressure in the conduit and generating a pressure value corresponding to the pressure; and

a conduit exit;

a controller monitor for generating a command to selectively prevent nitrogen flow;

a primary heat exchanger for receiving the air stream from the ducting assembly and cooling the air stream, the primary heat exchanger located downstream from the bleed air inlet and located downstream from the ram air inlet;

a gas generating system heat exchanger for receiving the air stream from the duct assembly, cooling the air stream, and providing the cooled air stream to the duct assembly;

an ejector for drawing an air source into the duct assembly and

over the gas generating system heat exchanger, the air source used by the gas generating system heat exchanger for cooling purposes, the ejector further used for ejecting a portion of the air stream, the ejector mechanically associated with duct assembly;

a filter for filtering contaminates from the air stream, the filter mechanically associated with the duct assembly;

a first temperature sensor and a second temperature sensor, each sensor for determining temperature in the duct assembly and generating a temperature value corresponding to the temperature, each temperature sensor mechanically associated with the duct assembly;

a controller monitor for receiving a temperature value and a pressure value, and generating a corresponding command signal;

a panel indicator for visual confirmation of component status, the panel indicator electronically associated with the controller monitor;

an altitude rate switch for monitoring changes in altitude and sending a signal corresponding to the change to the controller;

a valve for receiving and responding to the command signal, the valve selected from a group essentially comprising a pressure regulating and shutoff valve, a check valve, a flow shutoff valve, an ejector shutoff valve, a thermal shutoff valve, an ASM shutoff valve, and an isolation valve;

an air separation module (ASM) assembly having a primary module and a secondary module, each module for receiving the air stream from the duct assembly; separating nitrogen enriched air (NEA) from the air stream; and providing the NEA to the duct assembly, the ASM assembly located downstream from the temperature sensor;

a flow control orifice for receiving and regulating nitrogen flow from the ASM assembly via the duct assembly, the flow control orifice associated with a portion of the duct assembly located downstream from the ASM assembly; and

an NEA check valve for preventing entry of contaminants into the

ASM assembly, the check valve located downstream from the flow control orifice.

8. The system of Claim 7, wherein the control loop further comprises a primary control loop for receiving NEA from the primary ASM and a secondary control loop for receiving NEA from the secondary ASM.

9. The system of Claim 8, further comprising a primary flow shutoff valve associated with the primary control loop and a secondary flow shutoff valve associated with the secondary control loop.

10. The system of Claim 8, wherein the flow control orifice further comprises a primary flow control orifice associated with the primary control loop and a secondary flow control orifice associated with the secondary control loop.

11. The system of Claim 8, wherein the NEA check valve further comprises a primary NEA check valve associated with the primary control loop and a secondary NEA check valve associated with the second control loop, the primary NEA check valve and the secondary NEA check valve located upstream from the conduit exit.

12. A gas generating system comprising:

a duct assembly for ducting an air stream, the duct assembly having:

a bleed air inlet;

a ram air inlet;

an air stream exit;

a control loop system having a primary control loop and a secondary control loop, each control loop having:

a pressure sensor for determining pressure in the conduit and generating a pressure value corresponding to the pressure;

a conduit portion for ducting NEA; and

a conduit exit;

a primary heat exchanger for receiving the air stream from the ducting assembly and cooling the air stream, the primary heat exchanger located downstream from the bleed air inlet and located downstream from the ram air inlet;

a gas generating system heat exchanger for receiving the air stream from the duct assembly, cooling the air stream, and providing the cooled air stream to the duct assembly;

a first temperature sensor and a second temperature second, each temperature sensor for determining temperature in the duct assembly and generating a temperature value corresponding to the temperature, each temperature sensor mechanically associated with the duct assembly;

a controller monitor for receiving a temperature value and a pressure value, and generating a corresponding command signal;

a valve for receiving and responding to the command signal, the valve selected from a group essentially comprising a pressure regulating and shutoff valve, check valve, a flow shutoff valve, an ejector shutoff valve, a thermal shutoff valve, an ASM shutoff valve, and an isolation valve;

an air separation module (ASM) assembly having a primary

module and a secondary module, each module for receiving the air stream from the duct assembly; separating nitrogen enriched air (NEA) from the air stream; and providing the NEA to the duct assembly, the ASM assembly located downstream from the temperature sensor;

a primary flow shutoff valve for controlling NEA flow, the primary flow shutoff valve located downstream from the primary ASM and a secondary flow shutoff valve for controlling NEA flow, the secondary flow shutoff valve located downstream from the secondary ASM;

a primary flow control orifice and a secondary control orifice for controlling receiving and regulating NEA flow from the primary ASM and the ASM, respectively, via the duct assembly, the primary flow control orifice and the secondary control orifice associated with a portion of the duct assembly located downstream from the ASM assembly; and

a primary NEA check valve and a secondary NEA check valve for preventing entry of contaminants into the duct assembly, the primary NEA check valve and the secondary NEA check valve associated with the duct assembly.

13. The system of Claim 12, wherein the primary control loop further comprises:

a primary conduit for ducting the NEA from the primary ASM assembly to the conduit exit;

a primary pressure conduit for ducting the NEA from the primary ASM assembly to the conduit exit; and

a primary pressure sensor for monitoring pressure in the primary pressure conduit and sending a pressure value to the controller monitor.

14. The system of Claim 12, wherein the primary control loop further comprises a primary conduit exit for transfer of the NEA from the gas generating system.

15. The system of Claim 12, wherein the secondary control loop further comprises:

a secondary conduit for ducting the NEA from the ASM assembly to the conduit exit;

a secondary pressure conduit for ducting the NEA from the secondary ASM assembly to the conduit exit; and

a secondary pressure sensor for monitoring pressure in the secondary pressure conduit and sending a pressure value to the controller monitor.

16. The system of Claim 12, wherein the secondary control loop further comprises a secondary conduit exit for transfer of the NEA from the gas generating system.

17. A method for generating nitrogen enriched air from an air stream, the method comprising the steps of:

ducting the air stream via a duct assembly having:

a bleed air inlet;

a ram air inlet; and

an air stream exit;

receiving the air stream from the ducting assembly and cooling the air stream with a primary heat exchanger, the primary heat exchanger located downstream from the bleed air inlet and located downstream from the ram air inlet;

receiving the air stream from the duct assembly with a gas generating system heat exchanger, cooling the air stream, and providing the cooled air stream to the duct assembly;

determining temperature in the duct assembly and generating a temperature value corresponding to the temperature via a first temperature

sensor and a second temperature sensor, each temperature sensor mechanically associated with the duct assembly;

receiving a temperature value and a pressure value, and generating a corresponding command signal via a controller monitor;

receiving and responding to the command signal via a valve, the valve selected from a group essentially comprising a pressure regulating and shutoff valve, check valve, a flow shutoff valve, an ejector shutoff valve, a thermal shutoff valve, an ASM shutoff valve, and an isolation valve;

receiving the air stream from the duct assembly, separating nitrogen enriched air (NEA) from the air stream, and providing the NEA to the duct assembly via an air separation module (ASM) assembly having a primary module and a secondary module, the ASM assembly located downstream from the temperature sensor;

controlling NEA flow through the duct assembly from the ASM assembly to the conduit exit via the flow control orifice, the flow control orifice associated with a portion of the duct assembly located downstream from the ASM assembly; and

preventing the entry of contaminants into the duct assembly from the conduit exit.

18. The method of Claim 17, further comprising a step for drawing air into the duct assembly and over the gas generating system heat exchanger for cooling purposes, the air drawn via an ejector.

19. The method of Claim 17, further comprising a step for filtering contaminates from the air stream.

20. The method of Claim 17, further comprising a step for visually confirming component status via a panel indicator and, based on said status, providing a signal from the panel indicator to the controller monitor.

21. The method of Claim 17, further comprising a step for monitoring changes in altitude and sending a signal corresponding to the change to the controller monitor.

22. The method of Claim 17, wherein the step for ducting an air stream via a duct assembly further comprises steps of:

transferring NEA from the ASM assembly to the conduit exit via a control loop having a conduit portion;

determining pressure in the conduit portion and generating a pressure value corresponding to the pressure;

receiving the pressure value by the controller monitor; and

generating a command by the controller monitor to actuate the flow control shutoff valve and selectively prevent NEA flow therethrough.

23. A method for generating nitrogen enriched gas from an air stream, the method comprising steps of:

ducting an air stream through a duct assembly having:

a bleed air inlet;

a ram air inlet;

an air stream exit; and

a conduit exit;

receiving the air stream from the duct assembly and cooling the air stream with a primary heat exchanger located downstream from the bleed air inlet and located downstream from the ram air inlet;

receiving the air stream from the duct assembly, cooling the air stream, and providing the cooled air stream to the duct assembly with a gas generating system heat exchanger;

drawing air into the duct assembly and over the gas generating system heat exchanger for cooling purposes, the air drawn via an ejector

mechanically associated with the duct assembly;

ejecting a portion of the air stream via the ejector;

filtering contaminates from the air stream via a filter, the filter mechanically associated with the duct assembly;

determining temperature in the duct assembly and generating a temperature value corresponding to the temperature via a first temperature sensor and a second temperature sensor, the temperature sensors mechanically associated with the duct assembly;

receiving a temperature value and a pressure value, and generating a corresponding command signal via a controller monitor;

visually confirming component status via a panel indicator, the panel indicator electronically associated with the controller monitor;

monitoring changes in altitude and sending a signal corresponding to the change to the controller via an altitude monitor;

receiving and responding to the command signal via a valve, the valve selected from a group essentially comprising a pressure regulating and shutoff valve, check valve, a flow shutoff valve, an ejector shutoff valve, a thermal shutoff valve, an ASM shutoff valve, and an isolation valve;

receiving the air stream from the duct assembly; separating nitrogen enriched air (NEA) from the air stream; and providing nitrogen to the duct assembly via an air separation module (ASM) assembly having a primary module and a secondary ASM module, the ASM assembly located downstream from the temperature sensor;

controlling, receiving, and regulating nitrogen flow from the ASM assembly via the duct assembly via a flow control orifice, the flow control orifice associated with a portion of the duct assembly located downstream from the ASM assembly; and

preventing entry of contaminants into the duct assembly via an NEA check valve associated with the duct assembly.

24. The method of Claim 23, wherein the flow shutoff valve further comprises a first flow shutoff valve and a second flow shutoff valve.

25. The method of Claim 24, further comprising steps of:

transferring NEA from the primary module to the conduit exit via a primary control loop having a first conduit portion;

determining pressure in the first conduit portion and generating a pressure value corresponding to the pressure;

receiving the pressure value by the controller monitor; and

generating a command by the controller monitor to actuate the first flow control shutoff valve and to selectively prevent NEA flow therethrough.

26. The method of Claim 25, wherein the flow control orifice further comprises a secondary flow control orifice associated with the secondary control loop.

27. The method of Claim 26, wherein the NEA check valve further comprises a primary NEA check valve associated with the primary control loop.

28. The method of Claim 24, further comprising steps of:

transferring NEA from the secondary module to the conduit exit via a secondary control loop having a second portion;

determining pressure in the second conduit portion and generating a pressure value corresponding to the pressure;

receiving the pressure value by the controller monitor; and

generating a command by the controller monitor to actuate the second flow control shutoff valve and to selectively prevent NEA flow therethrough.

29. The method of Claim 28, wherein the flow control orifice further comprises a secondary flow control orifice associated with the secondary control loop.

30. The method of Claim 29, wherein the NEA check valve further comprises a secondary NEA check valve associated with the second control loop.

31. A method for separating nitrogen enriched air (NEA) from an air stream, the method comprising steps of:

receiving in and venting the air stream via an orifice of a duct assembly, the orifice including:

a bleed air inlet;

a ram air inlet; and

a ram exit; and

and a ram air overboard exit;

determining pressure in the duct assembly and generating a pressure value corresponding to the pressure via a pressure sensor;

determining temperature in first portion of the duct assembly and in a second portion of the duct assembly and generating a temperature value corresponding to each determined temperature via a first temperature sensor and a second temperature sensor, respectively;

receiving the pressure value and the temperature values, and generating a command base on the received values via a controller monitor, the command generated to selectively control flow to portions of the duct assembly via a controller monitor;

receiving the air stream from the ducting assembly and cooling the air stream via a primary heat exchanger, the primary heat exchanger located downstream from the bleed air inlet and located downstream from the ram air inlet;

receiving the air stream from the duct assembly, cooling the air stream, and providing the cooled air stream to the duct assembly via a gas generating system heat exchanger;

receiving and responding to the command signal via a valve, the valve selected from a group essentially comprising a pressure regulating and shutoff valve, a check valve, a flow shutoff valve, an ejector shutoff valve, a thermal shutoff valve, an ASM shutoff valve, and an isolation valve;

receiving the air stream from the duct assembly; separating nitrogen enriched air (NEA) from the air stream; and providing NEA to the duct assembly via an air separation module (ASM) assembly having a primary module and a secondary module, the ASM assembly located downstream from the temperature sensor;

controlling NEA flow from the ASM assembly via a primary flow shutoff valve located downstream from the primary ASM and a secondary flow shutoff valve, the secondary flow shutoff valve located downstream from the secondary ASM;

receiving and regulating NEA flow from the primary module via a primary flow control orifice and receiving and regulating NEA flow from the secondary module, the primary flow control orifice and the secondary control orifice associated with a portion of the duct assembly located downstream from the ASM assembly;

and preventing entry of contaminants into the duct assembly via a primary NEA check valve located downstream from the primary flow control orifice and a secondary NEA check valve located downstream from the secondary flow control orifice; and

transferring the NEA from the duct assembly via a conduit exit.

32. The method of Claim 31, further comprising steps of:

ducting the NEA from the primary module to a conduit exit via a primary pressure conduit;

monitoring pressure in the primary pressure conduit and sending a pressure value to the controller monitor; and

selectively enable or preventing flow of the NEA through the primary flow control shutoff valve by generating command signal from the controller monitor to the primary flow control shutoff valve.

33. The method of Claim 31, wherein the conduit exit further comprises a primary conduit exit located downstream from the primary NEA check valve.

34. The method of Claim 31, further comprising steps of:

ducting the NEA from the secondary module to the conduit exit via a secondary pressure conduit;

monitoring pressure in the secondary pressure conduit and sending a pressure value to the controller monitor; and

selectively enable or preventing flow of the NEA through the secondary flow control shutoff valve by generating command signal from the controller monitor to the secondary flow control shutoff valve.

35. The method of Claim 31, wherein the conduit exit further comprises a secondary conduit exit located downstream from the secondary NEA valve.

36. In a gas inerting system having a duct assembly with a conduit exit; a primary heat exchanger; a gas generating system heat exchanger; the gas generating system heat exchanger; a controller monitor; a valve assembly including a pressure regulating and shutoff valve mechanically associated with a portion of the duct assembly upstream from the primary heat exchanger and a thermal shutoff valve mechanically associated with a portion of the duct assembly downstream from the gas generating system heat exchanger; an air separation module (ASM) assembly having a primary module and a secondary module, the ASM assembly mechanically associated with a portion of the duct assembly upstream from the thermal shutoff valve; a flow control orifice; an NEA check valve and a control loop system, a redundant temperature control system comprising:

a first temperature sensor for determining temperature in the duct assembly and generating a first temperature value for the controller monitor; and

a second temperature sensor for determining temperature in a portion of the duct assembly located downstream from the first temperature sensor and upstream from the ASM assembly and for generating a second temperature value,

wherein the controller monitor receives the first temperature value and the second temperature value, selectively closes the pressure regulating and shutoff valve based on the received first temperature value, and selectively closes the thermal shutoff valve based on the received second temperature value.

37. The redundant temperature control system of Claim 36, wherein the first temperature sensor is mechanically associated with a portion of the duct assembly downstream from the gas generating system heat exchanger.

38. In a gas inerting system having a duct assembly with a conduit exit; a primary heat exchanger; a gas generating system heat exchanger; a first temperature sensor and a second temperature sensor; a controller monitor; a valve assembly including a pressure regulating and shutoff valve and a thermal shutoff valve; an air separation module (ASM) assembly having a primary module and a secondary module; a flow control orifice; and an NEA check, cooling system comprising:

an ejector for drawing air into the duct assembly and over the gas generating system heat exchanger for cooling purposes.

39. The cooling system of Claim 38, wherein the ejector further operates to receive a portion of an air stream from the gas generating system heat exchanger and vent the portion of the air stream into the duct assembly.